CLAIMS

[1] A flow rate/liquid type detecting apparatus for detecting the flow rate of a fluid and, at the same time, detecting any one of or both the type of the fluid and the concentration of the fluid, comprising:

a main passage through which a fluid to be detected flows;

an auxiliary passage branched from said main passage;

a flow rate/liquid type detecting sensor device provided in said auxiliary passage;

an auxiliary passage opening/closing valve provided in said auxiliary passage, for controlling the flow of the fluid to be detected into said flow rate/liquid type detecting sensor device; and

a control unit for controlling said flow rate/liquid type detecting sensor and said auxiliary passage opening/closing valve,

said control unit being constructed so as to conduct control in such a manner that;

in conducting any one of or both the detection of the type of said fluid to be detected and the detection of the concentration of said fluid to be detected, said auxiliary passage opening/closing valve is closed, and

said fluid to be detected is allowed to temporarily stay within said flow rate/liquid type detecting sensor device to conduct any one of or both the detection of the liquid type and the detection of the concentration, and;

in detecting the flow rate of the fluid to be detected, said auxiliary passage opening/closing valve is opened to allow the fluid to be detected to flow into said flow rate/liquid type detecting sensor device to detect the flow rate.

[2] The flow rate/liquid type detecting apparatus according to claim 1, characterized in that a non-return valve is provided on the downstream side of said flow rate/liquid type detecting sensor device in said auxiliary passage.

[3] The flow rate/liquid type detecting apparatus according to claim 1 or 2, characterized in that a main passage opening/closing valve for controlling the flow of said fluid to be detected into said main passage is provided in said main passage.

[4] The flow rate/liquid type detecting apparatus according to claim 3, characterized in that said control unit is

constructed so as to conduct control in such a manner that:

when the flow rate of said fluid to be detected is small, said main passage opening/closing valve is closed, and

when the flow rate of said fluid to be detected is large, said main passage opening/closing valve is opened.

[5] The flow rate/liquid type detecting apparatus according to any one of claims 1 to 4, characterized in that an orifice is provided in the main passage.

[6] The flow rate/liquid type detecting apparatus according to any of claims 1 to 5, characterized in that:

said flow rate/liquid type detecting sensor device comprises;

a flow rate/liquid type detecting chamber for allowing the fluid to be detected which has been introduced into a flow rate/liquid type detecting sensor device body to temporarily stay therein,

a flow rate/liquid type detecting sensor heater provided within said flow rate/liquid type detecting chamber, and

a liquid temperature sensor spaced by a given distance from said flow rate/liquid type detecting sensor heater and provided within said flow rate/liquid type detecting chamber,

said flow rate/liquid type detecting sensor heater comprising a heater and a flow rate/liquid type detecting liquid temperature sensor provided in the vicinity of said heater, and

said flow rate/liquid type detecting apparatus is constructed so that;

in conducting any one of or both the detection of the type of said fluid to be detected and the detection of the concentration of said fluid to be detected,

a pulse voltage is applied to said flow rate/liquid type detecting sensor heater for a predetermined period of time,

the fluid to be detected which temporarily stays within said flow rate/liquid type detecting chamber is heated with the heater, and

any one of or both the liquid type of the fluid and the concentration of the fluid are detected, by a voltage output difference V0, corresponding to a difference in temperature between the initial temperature and the peak temperature of said flow

rate/liquid type detecting liquid temperature sensor,

in detecting the flow rate of said fluid to be detected,

a pulse voltage is applied to said flow rate/liquid type detecting sensor heater for a predetermined period of time,

the fluid to be detected which flows through said flow rate/liquid type detecting chamber is heated with the heater, and

the flow rate is detected, by a voltage output difference V0, corresponding to a difference in temperature between the initial temperature and the peak temperature of said flow rate/liquid type detecting liquid temperature sensor.

[7] The flow rate/liquid type detecting apparatus according to claim 6, characterized in that the voltage output difference V0 is the difference in voltage between an average initial voltage V1, which is determined by sampling the initial voltage before the application of said pulse voltage by a predetermined number of times, and an average peak voltage V2, which is determined by sampling the peak voltage after the application of said pulse voltage by a predetermined number of times, that

is,

$V0 = V2 - V1$.

[8] The flow rate/liquid type detecting apparatus according to claim 6 or 7, characterized in that said control unit is constructed so that:

based on calibration curve data as a correlation between temperature and voltage output difference, for predetermined reference fluids previously stored in said control unit,

any one of or both the liquid type and concentration of said fluid to be detected are detected using said voltage output difference V0 obtained for said fluid to be detected.

[9] The flow rate/liquid type detecting apparatus according to any of claims 6 to 8, characterized in that said control unit is constructed so that:

a voltage output Vout for the voltage output difference V0 at a measuring temperature for said fluid to be detected is corrected in a correlation with the output voltage for the voltage output difference at the measuring temperature for a predetermined threshold reference fluid.

[10] The flow rate/liquid type detecting apparatus according to any of claims 6 to 9, characterized in that said control unit is constructed so that:

based on calibration curve data as a correlation between temperature and voltage output difference, for predetermined reference fluids previously stored in said control unit,

the flow rate of said fluid to be detected is detected using said voltage output difference V0 obtained for said fluid to be detected.

[11] The flow rate/liquid type detecting apparatus according to any of claims 6 to 10, characterized in that said flow rate/liquid type detecting sensor heater is a laminated flow rate/liquid type detecting sensor heater in which a heater and a flow rate/liquid type detecting liquid temperature sensor are laminated through an insulating layer.

[12] The flow rate/liquid type detecting apparatus according to any of claims 6 to 11, characterized in that the heater in said flow rate/liquid type detecting sensor heater and said flow rate/liquid type detecting liquid

temperature sensor each are constructed so as to come into contact with the fluid to be detected through a metallic fin.

[13] The flow rate/liquid type detecting apparatus according to any one of claims 6 to 12, characterized in that said liquid temperature sensor is constructed so as to come into contact with the fluid to be detected through said metallic fin.

[14] A flow rate/liquid type detecting method for detecting the flow rate of a fluid and, at the same time, detecting any one of or both the type of the fluid and the concentration of the fluid, characterized in that:

by using a flow rate/liquid type detecting apparatus comprising;

a main passage through which a fluid to be detected flows,

an auxiliary passage branched from said main passage, and

a flow rate/liquid type detecting sensor device provided in said auxiliary passage,

is provided, and

in conducting any one of or both the detection of

the type of said fluid to be detected and the detection of the concentration of said fluid to be detected, said auxiliary passage opening/closing valve is closed, and said fluid to be detected is allowed to temporarily stay within said flow rate/liquid type detecting sensor device to conduct any one of or both the detection of the liquid type and the detection of the concentration, and

in detecting the flow rate of the fluid to be detected, said auxiliary passage opening/closing valve is opened to allow the fluid to be detected to flow into said flow rate/liquid type detecting sensor device to detect the flow rate.

[15] The flow rate/liquid type detecting method according to claim 14, characterized in that a non-return valve is provided on the downstream side of said flow rate/liquid type detecting sensor device in said auxiliary passage.

[16] The flow rate/liquid type detecting method according to claim 14 or 15, characterized in that a main passage opening/closing valve for controlling the flow of said fluid to be detected into said main passage is provided in said main passage.

[17] The flow rate/liquid type detecting method according to claim 16, characterized in that control is carried out so that:

when the flow rate of said fluid to be detected is small, said main passage opening/closing valve is closed, and

when the flow rate of said fluid to be detected is large, said main passage opening/closing valve is opened.

[18] The flow rate/liquid type detecting method according to any one of claims 14 to 17, characterized in that an orifice is provided in the main passage.

[19] The flow rate/liquid type detecting method according to any of claims 14 to 18, characterized in that

said flow rate/liquid type detecting sensor device comprises:

a flow rate/liquid type detecting chamber for allowing the fluid to be detected which has been introduced into a flow rate/liquid type detecting sensor device body to temporarily stay therein,

a flow rate/liquid type detecting sensor heater

provided within said flow rate/liquid type detecting chamber, and

a liquid temperature sensor spaced by a given distance from said flow rate/liquid type detecting sensor heater and provided within said flow rate/liquid type detecting chamber,

said flow rate/liquid type detecting sensor heater comprising a heater and a flow rate/liquid type detecting liquid temperature sensor provided in the vicinity of said heater, and

said flow rate/liquid type detecting method comprising the steps of;

in conducting any one of or both the detection of the type of said fluid to be detected and the detection of the concentration of said fluid to be detected,

applying a pulse voltage to said flow rate/liquid type detecting sensor heater for a predetermined period of time,

heating with the heater, the fluid to be detected which temporarily stays within said flow rate/liquid type detecting chamber,

detecting any one of or both the liquid type of the fluid and the concentration of the fluid, by a voltage output difference V0, corresponding to a difference in

temperature between the initial temperature and the peak temperature of said flow rate/liquid type detecting liquid temperature sensor,

in detecting the flow rate of said fluid to be detected,

applying a pulse voltage to said flow rate/liquid type detecting sensor heater for a predetermined period of time,

heating, with the heater, the fluid to be detected which flows through said flow rate/liquid type detecting chamber, and

detecting the flow rate by a voltage output difference V0, corresponding to a difference in temperature between the initial temperature and the peak temperature of said flow rate/liquid type detecting liquid temperature sensor.

[20] The flow rate/liquid type detecting method according to claim 19, characterized in that the voltage output difference V0 is the difference in voltage between an average initial voltage V1, which is determined by sampling the initial voltage before the application of said pulse voltage by a predetermined number of times, and an average peak voltage V2, which is determined by

sampling the peak voltage after the application of said pulse voltage by a predetermined number of times, that is,

$V0 = V2 - V1$.

[21] The flow rate/liquid type detecting method according to claim 19 or 20, characterized in that:

based on calibration curve data as a correlation between temperature and voltage output difference, for predetermined reference fluids previously stored in said control unit,

any one of or both the liquid type and concentration of said fluid to be detected are detected using said voltage output difference V0 obtained for said fluid to be detected.

[22] The flow rate/liquid type detecting method according to any of claims 19 to 21, characterized in that:

a voltage output Vout for the voltage output difference V0 at a measuring temperature for said fluid to be detected is corrected in a correlation with the output voltage for the voltage output difference at the measuring temperature for a predetermined threshold reference fluid.

[23] The flow rate/liquid type detecting method according to any of claims 19 to 22, characterized in that:

based on previously stored calibration curve data as a correlation between temperature and voltage output difference for predetermined reference fluids,

the flow rate of said fluid to be detected is detected using said voltage output difference V0 obtained for said fluid to be detected.

[24] The flow rate/liquid type detecting method according to any of claims 19 to 23, characterized in that said flow rate/liquid type detecting sensor heater is a laminated flow rate/liquid type detecting sensor heater in which a heater and a flow rate/liquid type detecting liquid temperature sensor are laminated through an insulating layer.

[25] The flow rate/liquid type detecting method according to any of claims 19 to 24, characterized in that the heater in said flow rate/liquid type detecting sensor heater and said flow rate/liquid type detecting liquid temperature sensor each are constructed so as to come into contact with the fluid to be detected through a

metallic fin.

[26] The flow rate/liquid type detecting method according to any one of claims 19 to 25, characterized in that said liquid temperature sensor is constructed so as to come into contact with the fluid to be detected through said metallic fin.

[27] A flow rate/liquid type detecting apparatus for an automobile, for detecting the flow rate and type of gasoline or a light oil, characterized in that:

any of the above flow rate/liquid type detecting apparatuses is provided within a fuel tank or on the upstream side or downstream side of a fuel pump.

[28] A flow rate/liquid type detecting method for an automobile, for detecting the flow rate and type of gasoline or a light oil, comprising:

detecting the flow rate and type of said gasoline or light oil within a fuel tank or on the upstream side or downstream side of a fuel pump, by using the flow rate/liquid type detecting method according to any of claims 14 to 26.

[29] An automotive exhaust gas reduction apparatus comprising:

the flow rate/liquid type detecting apparatus according to any of claims 1 to 13 , which is provided within a fuel tank or on the upstream side or downstream side of a fuel pump; and

an ignition timing control unit for regulating ignition timing based on the flow rate and type of the gasoline or light oil, which is detected by said flow rate/liquid type detecting apparatus.

[30] An automotive exhaust gas reduction , comprising the steps of:

detecting the flow rate and type of the gasoline or light oil within a fuel tank or on the upstream side or downstream side of a fuel pump, by using the flow rate/liquid type detecting method according to any of claims 14 to 26, and

regulating an ignition timing based on the flow rate and type of the gasoline or light oil which is detected by said flow rate/liquid type detecting apparatus.

[31] An automotive exhaust gas reduction apparatus,

comprising:

the flow rate/liquid type detecting apparatus according to any of claims 1 to , which is provided within a fuel tank or on the upstream side or downstream side of a fuel pump; and

a gasoline or light oil compression control unit for regulating the compression ratio of the gasoline or light oil based on the flow rate and type of the gasoline or light oil, which is detected by said flow rate/liquid type detecting apparatus.

[32] An automotive exhaust gas reduction method, comprising the steps of:

detecting the flow rate and type of the gasoline or light oil within a fuel tank or on the upstream side or downstream side of a fuel pump, by using the flow rate/liquid type detecting method according to any of claims 14 to 26, and

regulating the compression ratio of the gasoline based on the flow rate and type of the gasoline or light oil which is detected by said flow rate/liquid type detecting apparatus.

[33] An automotive exhaust gas reduction apparatus,

comprising:

a urea solution feed mechanism for feeding a urea solution to the upstream side of a catalyst device,

said urea solution feed mechanism comprising a urea solution tank for storing a urea solution, a urea pump, a urea spray device for spraying the urea solution, which is supplied from said urea pump, toward the upstream side of said catalyst device, and

the flow rate/liquid type detecting apparatus according to any of claims 1 to 13 , which is provided within said urea tank or on the upstream side or downstream side of said urea pump.

[34] An automotive exhaust gas reduction method, , comprising the steps of:

supplying a urea solution to the upstream side of the catalyst device, through a urea solution feed mechanism comprising a urea solution tank for storing a urea solution, a urea pump, and a urea spray device for spraying the urea solution, which is supplied from said urea pump, toward the upstream side of said catalyst device, and

detecting the flow rate and urea concentration of the urea solution within said urea tank

or on the upstream side or downstream side of said urea pump, by using the flow rate/liquid type detecting method according to any of claims 14 to 26.

[35] A liquid type detecting apparatus for detecting any one of or both the liquid type and concentration of a fluid, comprising:

a liquid type detecting chamber for allowing a fluid to be detected which has been introduced into a liquid type detecting apparatus body to temporarily stay therein,

a liquid type detecting sensor disposed within said liquid type detecting chamber, and

a flow control plate provided within said liquid type detecting chamber so as to surround said liquid type detecting sensor.

[36] The liquid type detecting apparatus according to claim 35, characterized in that said flow control plate has a fluid inflow port confronted with a fluid introduction port in said liquid type detecting chamber and a fluid outflow port confronted with a fluid discharge port in said liquid type detecting chamber.

[37] The liquid type detecting apparatus according to claim 35 or 36, characterized in that the fluid introduction port in said liquid type detecting chamber and the fluid inflow port in said flow control plate are spaced from each other by a predetermined distance, and

the fluid discharge port in said liquid type detecting chamber and the fluid outflow port in said flow control plate are spaced from each other by a predetermined distance.

[38] The liquid type detecting apparatus according to any of claims 35 to 37, characterized in that the side wall in the vicinity of the fluid discharge port in said liquid type detecting chamber is provided in an approximately arc form.

[39] The liquid type detecting apparatus according to any of claims 35 to 38, characterized in that said liquid type detecting chamber is provided with an approximately circular tube side wall, and the fluid introduction port and the fluid discharge port in said liquid type detecting chamber are provided so as to confront said side wall.

[40] The liquid type detecting apparatus according to any of claims 35 to 39, characterized in that a heat insulating member is interposed between said liquid type detecting apparatus body and said liquid type detecting chamber.

[41] The liquid type detecting apparatus according to any of claims 35 to 40, characterized in that:

said liquid type detecting sensor comprises:

a liquid type detecting sensor heater provided within said liquid type detecting chamber, and

a liquid temperature sensor spaced by a given distance from said liquid type detecting sensor heater and provided within said liquid type detecting chamber,

said liquid type detecting sensor heater comprising a heater and a liquid type detecting liquid temperature sensor provided in the vicinity of said heater, and

in conducting any one of or both the detection of the type of said fluid to be detected and the detection of the concentration of said fluid to be detected,

a pulse voltage is applied to said liquid type detecting sensor heater for a predetermined period of time to heat,

the fluid to be detected which temporarily stays within said liquid type detecting chamber is heated

with the heater, and

any one of or both the liquid type of the fluid and the concentration of the fluid are detected, by a voltage output difference V0, corresponding to a difference in temperature between the initial temperature and the peak temperature of said liquid type detecting liquid temperature sensor.

[42] The liquid type detecting apparatus according to claim 41, characterized in that the voltage output difference V0 is the difference in voltage between an average initial voltage V1 determined by sampling the initial voltage before the application of said pulse voltage by a predetermined number of times and an average peak voltage V2 determined by sampling the peak voltage after the application of said pulse voltage by a predetermined number of times, that is,

$V0 = V2 - V1$.

[43] The liquid type detecting apparatus according to any of claims 41 to 42, characterized in that any one of or both the liquid type and concentration of said fluid to be detected are detected using said voltage output difference V0 obtained for said fluid to be detected,

based on previously stored calibration curve data as a correlation between temperature and voltage output difference for predetermined reference fluids.

[44] The liquid type detecting apparatus according to any of claims 41 to 43, characterized in that:

a voltage output Vout for the voltage output difference V0 at a measuring temperature for said fluid to be detected is corrected in a correlation with the output voltage for the voltage output difference at the measuring temperature for a predetermined threshold reference fluid.

[45] The liquid type detecting apparatus according to any of claims 41 to 44, characterized in that said liquid type detecting sensor heater is a laminated liquid type detecting sensor heater in which a heater and a liquid type detecting liquid temperature sensor are laminated through an insulating layer.

[46] The liquid type detecting apparatus according to any of claims 41 to 45, characterized in that the heater in said liquid type detecting sensor heater and said liquid type detecting liquid temperature sensor each are

constructed so as to come into contact with the fluid to be detected through a metallic fin.

[47] The liquid type detecting apparatus according to any one of claims 41 to 46, characterized in that said liquid temperature sensor is constructed so as to come into contact with the fluid to be detected through said metallic fin.

[48] A liquid type detecting method for detecting any one of or both the liquid type and concentration of a fluid, comprising the steps of:

providing a liquid type detecting apparatus comprising;

a liquid type detecting chamber for allowing a fluid to be detected which has been introduced into a liquid type detecting apparatus body to temporarily stay therein,

a liquid type detecting sensor disposed within said liquid type detecting chamber, and

a flow control plate provided within said liquid type detecting chamber so as to surround said liquid type detecting sensor, and

stopping the introduction of the fluid to be

detected into said liquid type detecting apparatus body,

allowing the fluid to be detected to temporarily stay within said liquid type detecting chamber, and

conducting the detection of any one of or both the liquid type and concentration of the fluid to be detected.

[49] The liquid type detecting method according to claim 48, characterized in that said flow control plate has a fluid inflow port confronted with a fluid introduction port in said liquid type detecting chamber and a fluid outflow port confronted with a fluid discharge port in said liquid type detecting chamber.

[50] The liquid type detecting method according to claim 48 or 49, is characterized in that the fluid introduction port in said liquid type detecting chamber and the fluid inflow port in said flow control plate are spaced from each other by a predetermined distance, and

the fluid discharge port in said liquid type detecting chamber and the fluid outflow port in said flow control plate are spaced from each other by a predetermined distance.

[51] The liquid type detecting method according to any of claims 48 to 50, characterized in that the side wall in the vicinity of the fluid discharge port in said liquid type detecting chamber is provided in an approximately arc form.

[52] The liquid type detecting apparatus according to any of claims 48 to 51, characterized in that said liquid type detecting chamber is provided with an approximately circular tube side wall, and the fluid introduction port and the fluid discharge port in said liquid type detecting chamber are provided so as to confront said side wall.

[53] The liquid type detecting method according to any of claims 48 to 52, characterized in that a heat insulating member is interposed between said liquid type detecting apparatus body and said liquid type detecting chamber.

[54] The liquid type detecting method according to any of claims 48 to 53, characterized in that:

said liquid type detecting sensor comprises:

a liquid type detecting sensor heater provided within said liquid type detecting chamber, and

a liquid temperature sensor spaced by a given distance from said liquid type detecting sensor heater and provided within said liquid type detecting chamber,

said liquid type detecting sensor heater comprising a heater and a liquid type detecting liquid temperature sensor provided in the vicinity of said heater, and

in conducting any one of or both the detection of the type of said fluid to be detected and the detection of the concentration of said fluid to be detected,

a pulse voltage is applied to said liquid type detecting sensor heater for a predetermined period of time to heat,

the fluid to be detected which temporarily stays within said liquid type detecting chamber is heated with the heater, and

any one of or both the liquid type of the fluid and the concentration of the fluid are detected, by a voltage output difference V0, corresponding to a difference in temperature between the initial temperature and the peak temperature of said liquid type detecting liquid temperature sensor.

[55] The liquid type detecting method according to claim 54, characterized in that the voltage output difference V0

is the difference in voltage between an average initial voltage V1 determined by sampling the initial voltage before the application of said pulse voltage by a predetermined number of times and an average peak voltage V2 determined by sampling the peak voltage after the application of said pulse voltage by a predetermined number of times, that is,

$V0 = V2 - V1$.

[56] The liquid type detecting method according to any of claims 54 to 55, characterized in that any one of or both the liquid type and concentration of said fluid to be detected are detected using said voltage output difference V0 obtained for said fluid to be detected, based on previously stored calibration curve data as a correlation between temperature and voltage output difference for predetermined reference fluids.

[57] The liquid type detecting method according to any of claims 54 to 56, characterized in that:

a voltage output Vout for the voltage output difference V0 at a measuring temperature for said fluid to be detected is corrected in a correlation with the output voltage for the voltage output difference at the

measuring temperature for a predetermined threshold reference fluid.

[58] The liquid type detecting method according to any of claims 54 to 57, characterized in that said liquid type detecting sensor heater is a laminated liquid type detecting sensor heater in which a heater and a liquid type detecting liquid temperature sensor are laminated through an insulating layer.

[59] The liquid type detecting method according to any of claims 54 to 58, characterized in that the heater in said liquid type detecting sensor heater and said liquid type detecting liquid temperature sensor each are constructed so as to come into contact with the fluid to be detected through a metallic fin.

[60] The liquid type detecting method according to any one of claims 54 to 59, characterized in that said liquid temperature sensor is constructed so as to come into contact with the fluid to be detected through said metallic fin.

[61] A liquid type detecting apparatus for an automobile, for

detecting the type of gasoline or a light oil, comprising:

the liquid type detecting apparatus according to any of claims 35 to 47, which is provided within a fuel tank or on the upstream side or downstream side of a fuel pump.

[62] A liquid type detecting method for an automobile, for detecting the type of gasoline or a light oil, comprising:

detecting the type of said gasoline or light oil within a fuel tank or on the upstream side or downstream side of a fuel pump, by using the liquid type detecting method according to any of claims 48 to 60.

[63] An automotive exhaust gas reduction apparatus, comprising:

the liquid type detecting apparatus according to any of claims 35 to 47, which is provided within a fuel tank or on the upstream side or downstream side of a fuel pump; and

an ignition timing control unit for regulating ignition timing based on the type of the gasoline or light oil, which is detected by said liquid type detecting apparatus.

[64] An automotive exhaust gas reduction method, comprising the steps of:

detecting the type of the gasoline or light oil within a fuel tank or on the upstream side or downstream side of a fuel pump, by using the liquid type detecting method according to any of claims 48 to 60, and

regulating an ignition timing based on the type of the gasoline or light oil which is detected by said liquid type detecting apparatus.

[65] An automotive exhaust gas reduction apparatus, comprising:

the liquid type detecting apparatus according to any of claims 35 to 47, which is provided within a fuel tank or on the upstream side or downstream side of a fuel pump; and

a gasoline or light oil compression control unit for regulating the compression ratio of the gasoline or light oil based on the type of the gasoline or light oil which is detected by said liquid type detecting apparatus.

[66] An automotive exhaust gas reduction method, comprising

the steps of:

detecting the type of the gasoline or light oil within a fuel tank or on the upstream side or downstream side of a fuel pump, by using the liquid type detecting method according to any of claims 48 to 60, and

regulating the compression ratio of the gasoline based on the type of the gasoline or light oil which is detected by said liquid type detecting apparatus.

[67] An automotive exhaust gas reduction apparatus, , comprising:

a urea solution feed mechanism for feeding a urea solution to the upstream side of a catalyst device,

said urea solution feed mechanism comprising a urea solution tank for storing a urea solution, a urea pump, a urea spray device for spraying the urea solution, which is supplied from said urea pump, toward the upstream side of said catalyst device, and

the liquid type detecting apparatus according to any of claims 35 to 47, which is provided within said urea tank or on the upstream side or downstream side of said urea pump.

[68] An automotive exhaust gas reduction method, , comprising

the steps of:

supplying a urea solution to the upstream side of the catalyst device, through a urea solution feed mechanism comprising a urea solution tank for storing a urea solution, a urea pump, and a urea spray device for spraying the urea solution, which is supplied from said urea pump, toward the upstream side of said catalyst device, and

detecting the urea concentration of the urea solution within said urea tank or on the upstream side or downstream side of said urea pump, by using the liquid type detecting method according to any of claims 48 to 60.